Active Project (2015 - 2017)

High Heat Flux Block Ablator-in-Honeycomb Heat Shield Using Ablator/Aerogel-Filled Foam, Phase II Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)

ABSTRACT

Ultramet and ARA Ablatives Laboratory previously developed and demonstrated foam-reinforced carbon/phenolic ablators that offer substantially increased high heat flux performance and reduced weight relative to conventional ablators. The structure consisted of an ablator-filled foam front surface backed by Ultramet's highly insulating aerogel-filled foam. Arcjet testing was performed at NASA ARC to heat flux levels exceeding 1000 W/cm2, with the results showing a significantly reduced ablation rate compared to conventional chopped fiber ablators, and ablation behavior comparable to FM5055 at just one-third the density. In 2008, NASA ARC contracted ARA to develop a new heat shield design involving integration of fully cured mid-density ablator blocks within a structural honeycomb reinforcement. The block ablator-in-honeycomb heat shield is envisioned to provide high atmospheric entry reliability due to the structural attachment integrity provided by the honeycomb lattice in the ablative material layer. In Phase I, the Ultramet-ARA team demonstrated the initial feasibility of using ablator/aerogel-filled foam within honeycomb cells through fabrication of a 16-cell panel in which foam blocks were literally pressed to shape using a die and then snug-fit into carbon/phenolic honeycomb cells. The 16-cell panel was infiltrated with ablator to a controlled depth on the front face, which simultaneously bonded the foam blocks to the honeycomb, and the remaining foam void space on the back face was filled with aerogel. In Phase II, block ablator-in-honeycomb structures will be optimized through flat and curved panel fabrication, properties testing, and high heat flux testing at NASA ARC and the Air Force LHMEL facility. This effort will leverage a current Ultramet project for NASA ARC focusing on optimization of ablator-filled foam compositions for use in the 1000-8000 W/cm2 heat flux range, which could ultimately be used in the block ablator-in-honeycomb architecture.

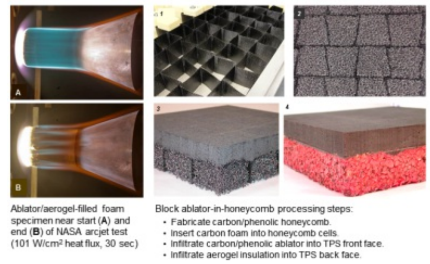

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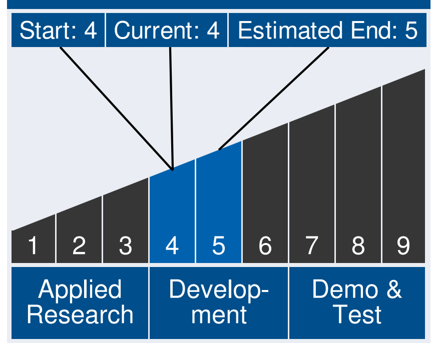
Table of Contents

Abstract 1
Technology Maturity 1
Management Team 1
Anticipated Benefits 2
Technology Areas 2
U.S. Work Locations and Key Partners 3
Details for Technology 1 4

Technology Maturity



Management Team

Program Executives:

- Joseph Grant
- Laguduva Kubendran

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ANTICIPATED BENEFITS

To NASA funded missions:

Potential NASA Commercial Applications: The proposed block ablator-in-honeycomb heat shield is anticipated to meet NASA requirements for increased heat flux capability and reduced mass in entry vehicle thermal protection systems. NASA applications include the Orion Multi-Purpose Crew Vehicle for beyond Earth orbit exploration (entry, descent, and landing heat shield and backshell), asteroid sample return, and planetary sample return. Earth return can have an entry velocity greater than 11.5 km/s and a heat flux in the 1500-2500 W/cm2 range or higher. Use of ablators in rocket nozzles has been extensive, and NASA also stands to benefit in that application.

To the commercial space industry:

Potential Non-NASA Commercial Applications: Non-NASA applications include solid rocket motors for conventional satellite launch, nanosatellite launch systems, launch platform protection, tactical missile solid rocket motors, internal and external motor case insulation, throats, and nosetips.

Management Team *(cont.)*

Program Manager:
- Carlos Torrez

Principal Investigator:
- Brian Williams

Technology Areas

Primary Technology Area:
Entry, Descent, and Landing Systems (TA 9)
└─ Aeroassist and Atmospheric Entry (TA 9.1)
  └─ Thermal Protection Systems for Rigid Decelerators (TA 9.1.1)
    └─ Conformal Ablative Thermal Protection System (TPS) (TA 9.1.1.3)

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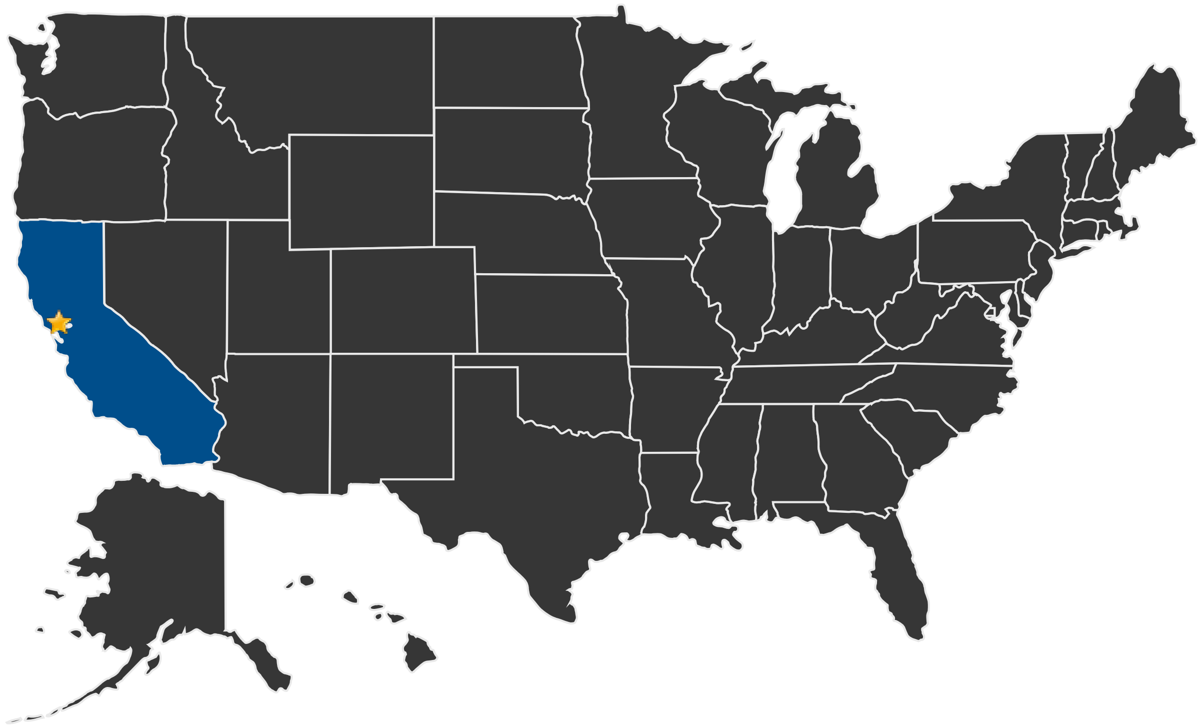
U.S. WORK LOCATIONS AND KEY PARTNERS



U.S. States With Work

Lead Center:
Ames Research Center

Other Organizations Performing Work:

- Ultramet (Pacoima, CA)

PROJECT LIBRARY

Presentations

- Briefing Chart
  - (http://techport.nasa.gov:80/file/18112)

DETAILS FOR TECHNOLOGY 1

Technology Title

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